

# *The Role of “Innovation” in Minimizing the Environmental Effects of Offshore Oil & Gas Activities.*

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# Environmental Effects of Offshore Oil and Gas

## *Role of Innovation*

- Continued Improvements in Drilling Technology
- Innovation in Treatment and Disposal Technologies for Waste Streams
- Development of High Performance WBM Substitutes for OBM and SBM
- Deployment of Effective Management Systems to Ensure Regulatory Compliance and Protect Worker Health and Safety

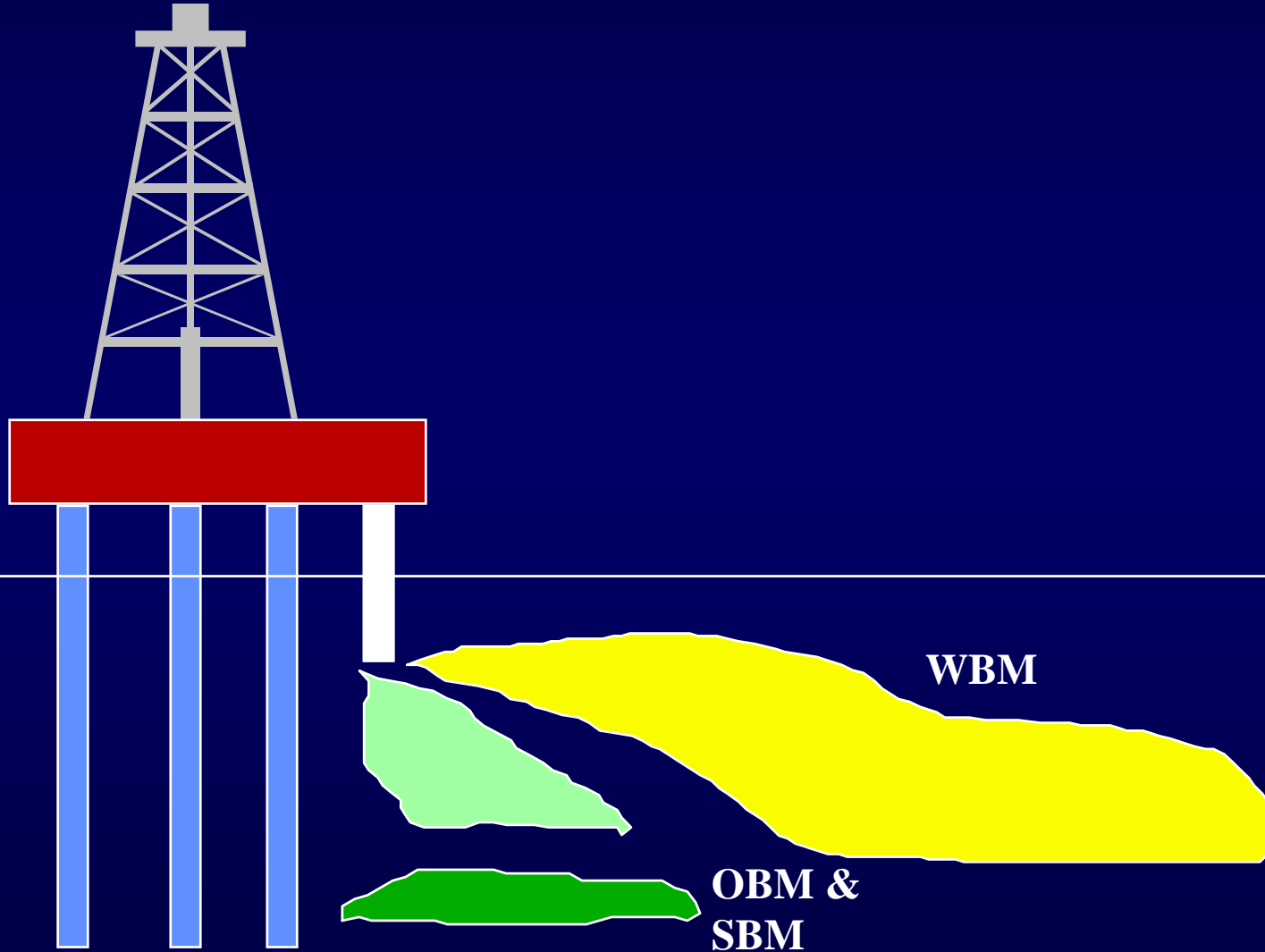
# Offshore Environmental Considerations

*Fate and Effects*

- Potential areas of concern
  - ❖ Fishing industry
  - ❖ Sea mammals
  - ❖ Birds
  - ❖ Coral reefs
  - ❖ Human health through consumption of seafood

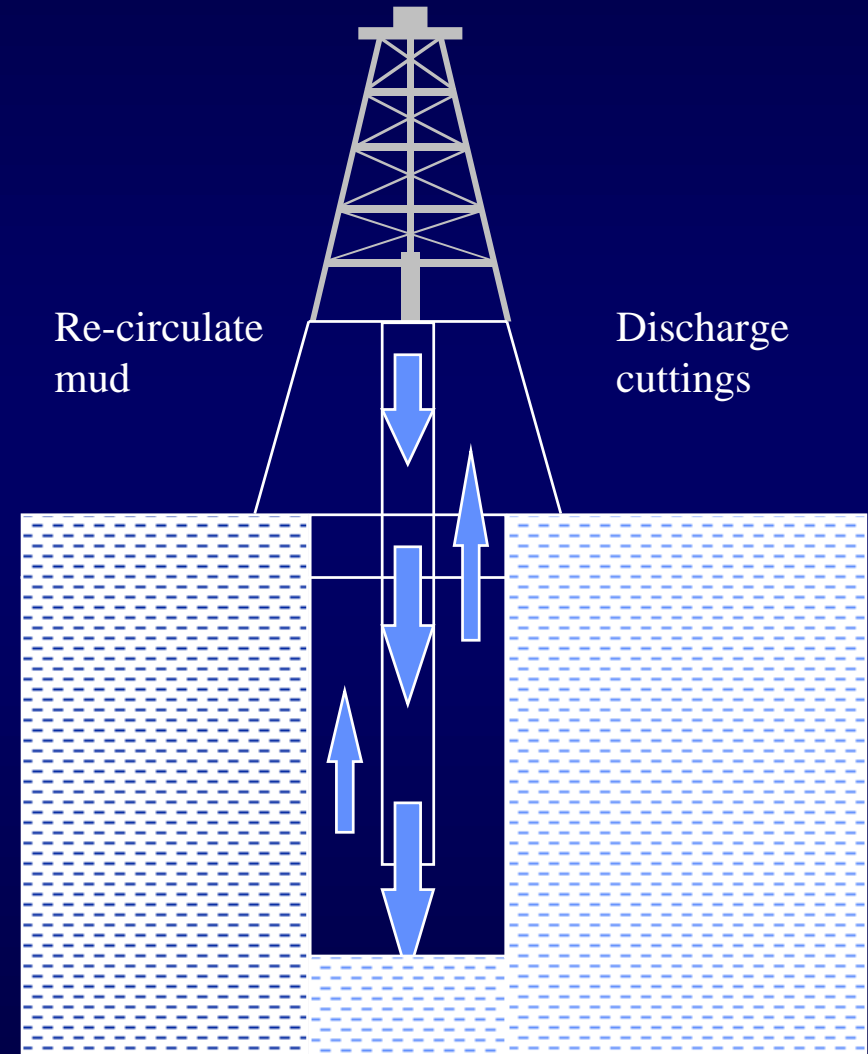
# Environmental Considerations

## OBM, SBM and WBM Discharge



# Primary Functions of Drilling Fluids

- Remove cuttings from wellbore
- Stabilize wellbore
- Control subsurface pressures

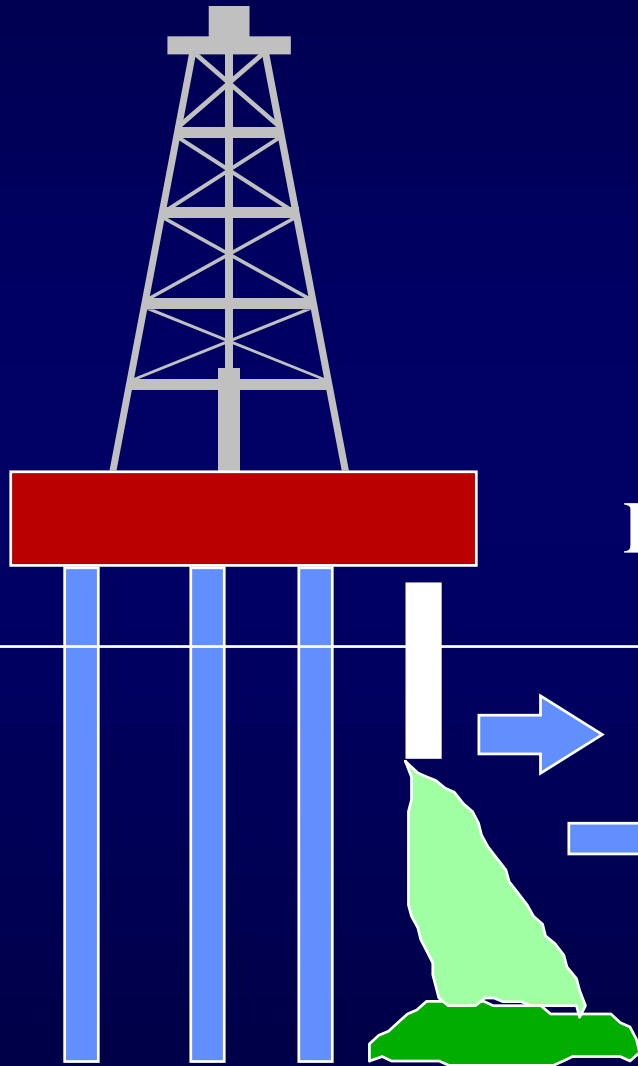


# Environmental Considerations WBM

- Potential toxicants
  - ❖ Heavy metals - barite
  - ❖ Organic compounds - lubricants
  - ❖ Surfactants - mud thinners / shale inhibitors
- Potential impacts
  - ❖ Typically considered low
  - ❖ Water column toxicity
  - ❖ Benthic impacts on sensitive areas

# Environmental Considerations

## OBM & SBM



PARCOM AGREED FACTS 1985



0-500 m cuttings pile



200-1000 m transition zone



1000-4000 m detectable  
contamination

# Environmental Considerations

## OBM & SBM

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- Potential toxicants
  - ❖ Organic loading
  - ❖ Smothering
  - ❖ Toxic Organics
  - ❖ Heavy metals - from barite
- Potential impacts
  - ❖ Toxic impact on benthic community
  - ❖ Duration of impact on benthic community



# Water-Based Mud Operational Challenges

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- Difficulty with reactive clay formations
- Stuck pipe problems
- Lubricity problems

# Oil-Based Mud

## Operational Challenges

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- Discharge of OBM and cuttings severely restricted
- Logistical problems of handling cuttings disposal limit rate of penetration
- Spill liability

# Synthetic-Based Mud

## Operational Challenges

- Higher cost per barrel compared to water-based mud and oil-based mud
- Loss of whole mud to the formation can be a very expensive problem
- Regulatory considerations

# Improved Functions of Synthetic-Based Muds

- Shale stability
- Lubricity
- Rate of Penetration
- Borehole stability
- Corrosion protection

# Non-Water Quality Advantages Compared to Oil-Based Muds

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- Source reduction of priority pollutants and toxic organics
- Reduction in air pollution from not hauling cuttings
- Reduction in potential accidents from not transporting cuttings
- Reduction in spill potential for diesel and mineral oil
- Reduction in exposure to toxic organic fumes for workers
- Elimination of cross media contamination

# Innovative Drilling Fluid Systems

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- LV Esters
- Silicate Systems
- Reversible Systems
- Total Fluids Management

# Innovative Drilling Fluid Systems

## *Low Viscosity Esters*

- Conventional esters show
  - ❖ Operational excellence
  - ❖ Best in class environmental performance-Toxicity/biodegradation
- Until now mostly used in relatively shallow water-high viscosity for deep water use
- New low viscosity esters show excellent operational characteristics and excellent environmental performance

# Innovative Drilling Fluid Systems

## *Silicates*

- Silicates used in oilfield for decades
- Return to these fluids as environmental restrictions increase
- Re-evaluation of the membrane forming ability of silicates
- Improvements in WBM performance through silicate design and fluid engineering



# Silicate Drilling Fluids

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## Health, Safety and Environmental Aspects

- Class E rating for North Sea (unlimited discharge)
- PSAC List (Microtox testing passed)
- Mysidopsis shrimp test passed in Gulf of Mexico

# Silicate Drilling Fluids

## *Marine Benefits of Silicate “Fertilizer for the Sea”*

- Silicates increase rate of diatom growth
- Silicates increase green algae growth
- Faster growth of mussels, scallops, oysters...
- 4 year EU project on “marine cultivation” with silicate

- Silicate based drilling fluids are growing popularity
- Silicates have a unique chemistry
- Silicates are versatile
- Silicates can be beneficial to an ocean environment

# Innovative Drilling Fluid Systems

*Total Fluids Management*

- A new look at operations offshore
- Waste Minimization
  - ❖ Achieving improved environmental performance and cost reductions
- Applying Best Management Practices
  - ❖ Rig audits, Best Available Technology

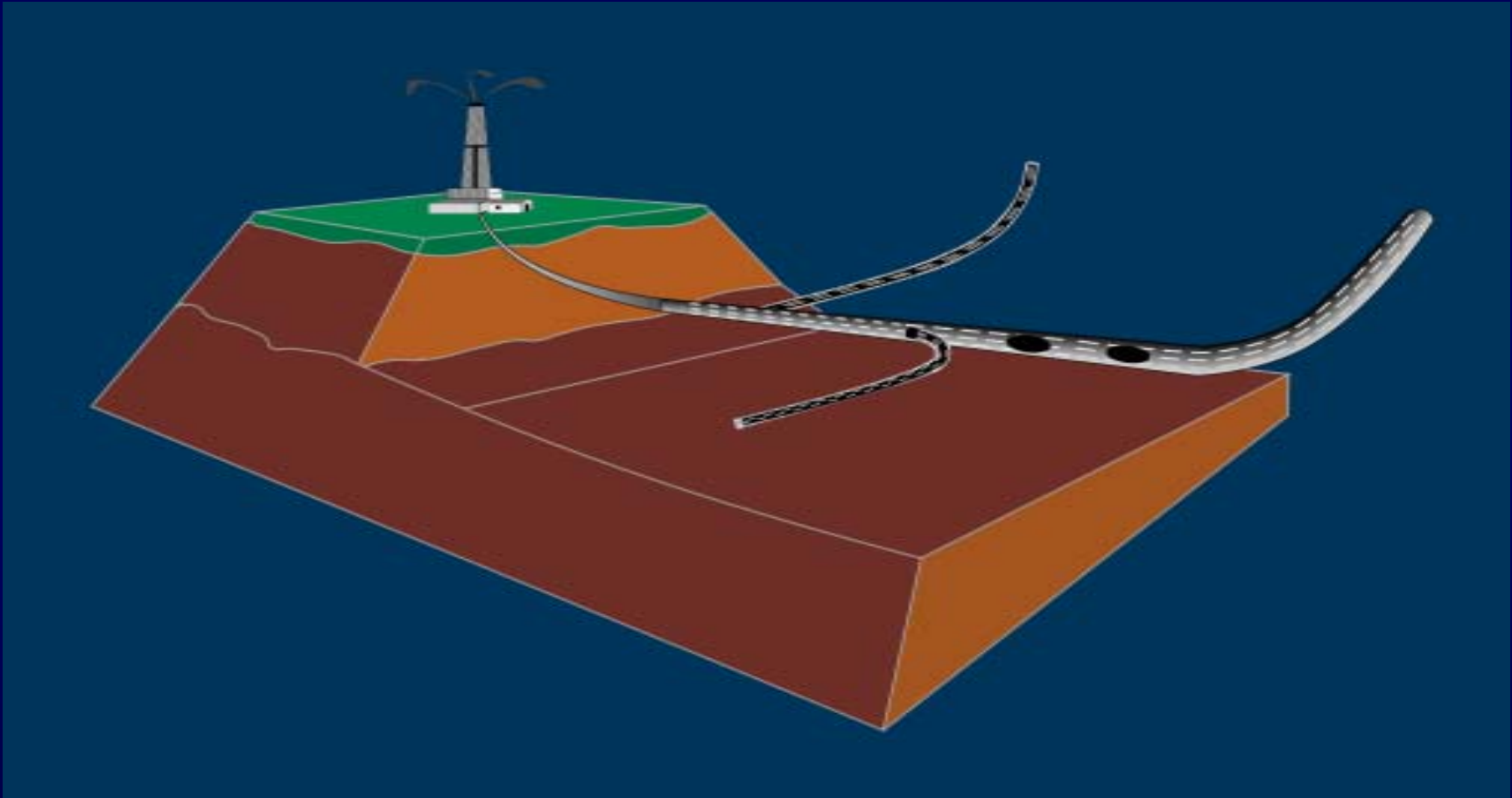
- Process Management
  - ❖ Benchmarking
  - ❖ Measurement
  - ❖ Peer Review
  - ❖ Continuous Improvement

- Advantages
  - ❖ Reduced Drilling Fluid Volumes
  - ❖ Less Environmental Impact
- Disadvantages
  - ❖ Unfavorable Fluid Hydraulics
  - ❖ Narrow Tolerances

# Multilateral Completions

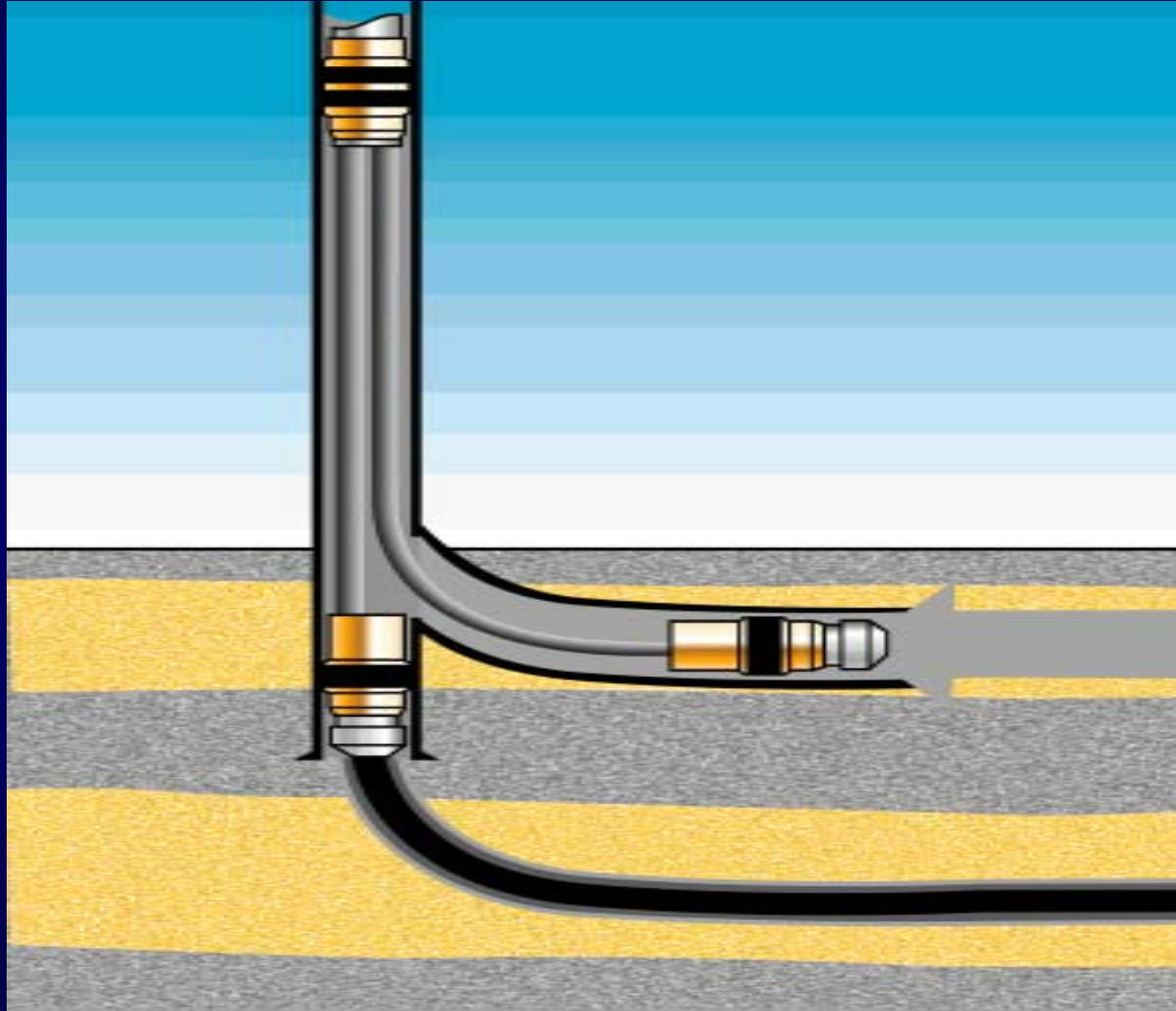
*Case History:  
CS Resources (Canada)*

**Total Reservoir Exposure: 4000 Meters**



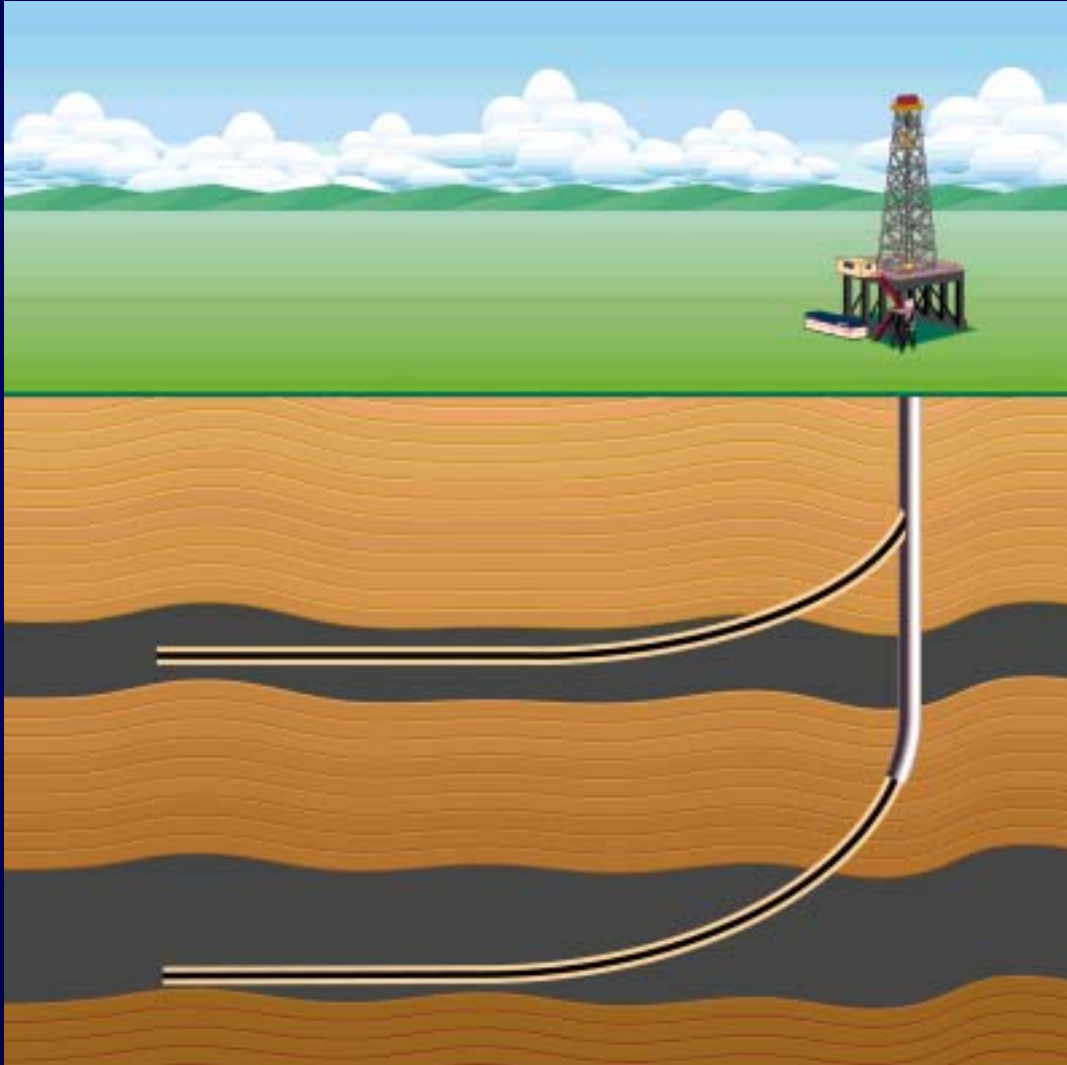


# Multilateral Completions



Dual Completion

# Multilateral Completions



**Draining Multiple  
Reservoirs**

# Multilateral Completions

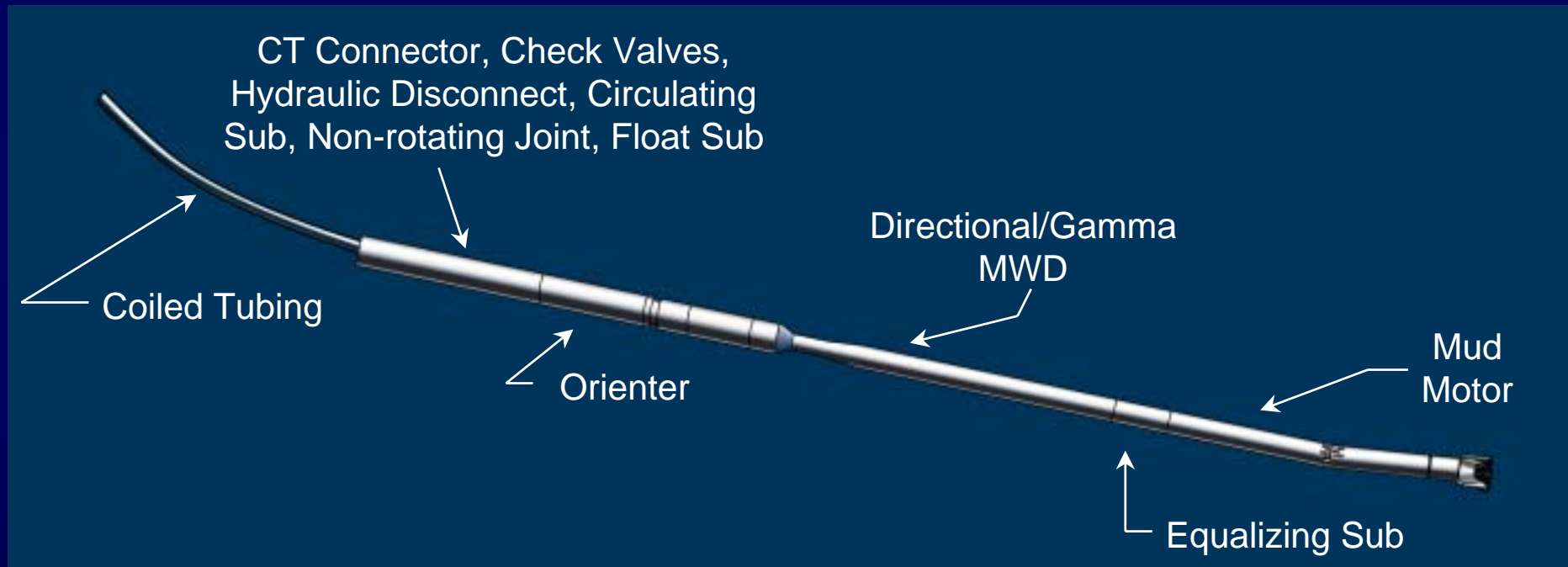
*Drivers*

**Economic** —————> **Drivers** <———— **Environmental**

- Enhance production capabilities
- Reduce development well numbers
- Reduce slot requirements
- Improve EOR sweep effectiveness

- Multiple Drainholes
- Mechanical and Hydraulic Integrity
- Reentry Capability
- Selective Flow Control

### Bottom Hole Assembly (BTA)



# Environmental Effects of Offshore Oil and Gas

## *Conclusions*

1. Innovations in Drilling and Completions Technology Combined with New Technological Developments in Drilling Fluids have Significantly Reduced the Environmental Impact of Offshore E&P
2. Treatment Technologies for Offshore Drilling Waste Streams While Available are Impacted by Space and Cost Limitations

# Environmental Effects of Offshore Oil and Gas

## *Conclusions*

3. The Advent of High Performance Cost Competitive WBM Substitutes for OBM/SBM Will Further Reduce Environmental Impact
4. “Engaging” Regulatory Agencies and NGO’s May be Critical to the Long Term Viability of the E&P Industry